OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **ZEPHYR LAKE** the program coordinators recommend the following actions.

FIGURE INTERPRETATION

- Figure 1: These graphs illustrate concentrations of chlorophyll-a in the water column. Algae are microscopic plants that are a natural part of lake ecosystems. Algae contain chlorophyll-a, a pigment necessary for photosynthesis. A measure of chlorophyll-a can indicate the abundance of algae in a lake. The historical data (the bottom graph) show a *stabilizing* in-lake chlorophyll-a trend. Chlorophyll concentration in July was indicative of increased algal production in the lake. The June plankton sample revealed that the blue-green alga, *Anabaena,* was the second most abundant algae in the lake. Blue-green algae can be indicators of pollutants and are nuisance algae when they become overly abundant. It is possible that *Anabaena* bloomed in July, however we cannot confirm this. There were no phosphorus results for July, but phosphorus concentration in August was elevated, which could may influence algal growth. Productivity in June and August was below the NH mean reference line. While algae are present in all lakes, an excess amount of any type is not welcomed. Concentrations can increase when there are internal and external sources of phosphorus, which is the nutrient algae depend upon for growth. It's important to continue the education process and keep residents aware of the sources of phosphorus and how it influences lake quality.

- Figure 2: Water clarity is measured by using a Secchi disk. Clarity, or transparency, can be influenced by such things as algae, sediments from erosion, and natural colors of the water. The graphs on this page show historical and current year data. The lower graph shows a *stable* trend in lake transparency. Transparency readings in July were the highest this season, and the abundance of algae did not seem to decrease the clarity of the water. Windy weather during the June sampling session likely decreased the Secchi disk reading at that time. The 2000 sampling season was considered to be wet and, therefore, average transparency readings are expected to be slightly lower than last year's readings. Higher amounts of rainfall usually cause more eroding of sediments into the lake and streams, thus decreasing clarity.

- Figure 3: These figures show the amounts of phosphorus in the epilimnion (the upper layer in the lake) and the hypolimnion (the lower layer); the inset graphs show current year data. Phosphorus is the limiting nutrient for plants and algae in New Hampshire waters. Too much phosphorus in a lake can lead to increases in plant growth over time. These graphs show a *slightly improving* trend for in-lake phosphorus levels. Phosphorus concentration in June was quite low for both layers, but increased to above the NH median by August. As lakes age, and the summer progresses, dissolved oxygen is depleted in the hypolimnion. As oxygen is depleted phosphorus normally bound to the sediments is released into the water column raising phosphorus concentrations in the water. This could explain the increase in hypolimnetic phosphorus levels in August. One of the most important approaches to reducing phosphorus levels is educating the public. Humans introduce phosphorus to lakes by several means: fertilizing lawns, septic system failures, and detergents containing phosphates are just a few. Keeping the public aware of ways to reduce the input of phosphorus to lakes means less productivity in the lake. Contact the VLAP coordinator for tips on educating your lake residents or for ideas on testing your watershed for phosphorus inputs.

OTHER COMMENTS

- In 2000, small amounts of the blue-green alga *Anabaena* were observed in the plankton sample (Table 2). The blue-green alga *Microcystis* has been found in the lake since 1996. Blue-green algae can reach nuisance levels when sufficient nutrients and favorable environmental conditions are present. We recommend scheduling your annual lake visit with VLAP Coordinator in July or August, as blue-greens tend to flourish in mid to late summer. Continued care to protect the watershed by limiting or eliminating fertilizer use on lawns, keeping the lake shoreline natural, and properly maintaining septic systems and roads will keep algae populations in balance.

- The pH of the inlet continues to be low, however it did increase slightly this season (Table 4). The Inlet flows directly from a wetland. The decomposition of plants can release tannic acids, thereby naturally decreasing the pH of the water.

- Overall, conductivity decreased from last season due to the increase in rainfall (Table 6). This helped to dilute the pollutant accumulation. The decrease in conductivity is a good sign, however conductivity has been increasing over the years. Conductivity increases often indicate the influence of human activities on surface waters. Septic system leachate, agricultural runoff, iron deposits, and road runoff can all influence conductivity. It would be useful to uncover the reasons for increased conductivity as we continue to monitor the lake.

- Bacteria concentration at the public beach was zero in June (Table 12). The state standard is 88 counts per 100 mL for public bathing places. Monitors may wish to repeat this test on a weekend when beach use is heavy. Because bacteria die quickly in cool pond waters, testing is most accurate and most representative of health risk to bathers when the source (humans, or perhaps waterfowl) is present.

NOTES

- Monitor's Note (6/21/00): Inlet flow from wetland.

- Biologist's Note (6/21/00): No dissolved oxygen/temperature profile, too windy.

USEFUL RESOURCES

The Blue Green Algae. North American Lake Management Society, 1989. (608) 233-2836 or www.nalms.org

Wetlands: More Important Than You Think, NHDES Booklet, (603) 271-3503 or www.state.nh.us

Save Our Streams Handbook for Wetlands Conservation and Sustainability. (800) BUG-IWLA, or visit www.iwla.org

A Brief History of Lakes, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

Answers to Common Lake Questions, NHDES-WSPCD-92-12, NHDES Booklet, (603) 271-3503.

Phosphorus in Lakes, WD-BB-20, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Effects of Phosphorus on New Hampshire's Lakes, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

Vegetated Shoreline Buffers, video, North Country RC&D, (603) 527-2093

Nonpoint Source Pollution and Stormwater Fact Sheet Package. Terrene Institute. (800) 726-5253, or www.terrene.org

Road Salt and Water Quality, WD-WSQB-7, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

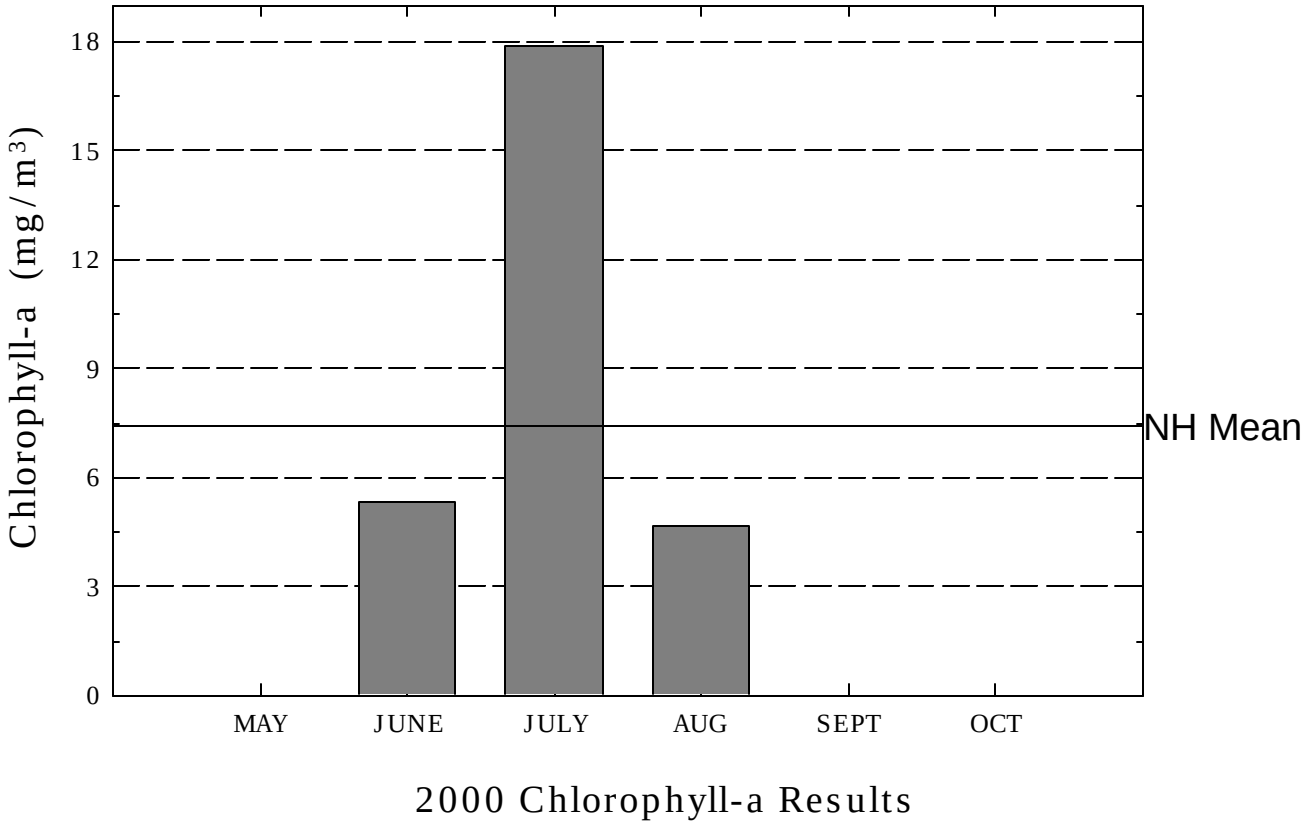
Freshwater Wetlands: A Guide to Common Indicator Plants of the Northeast. By Dennis Magee, Univ. of Massachusetts Press, 1981. (413) 545-0111, or www.umass.edu/umext/bookstore.html

2000

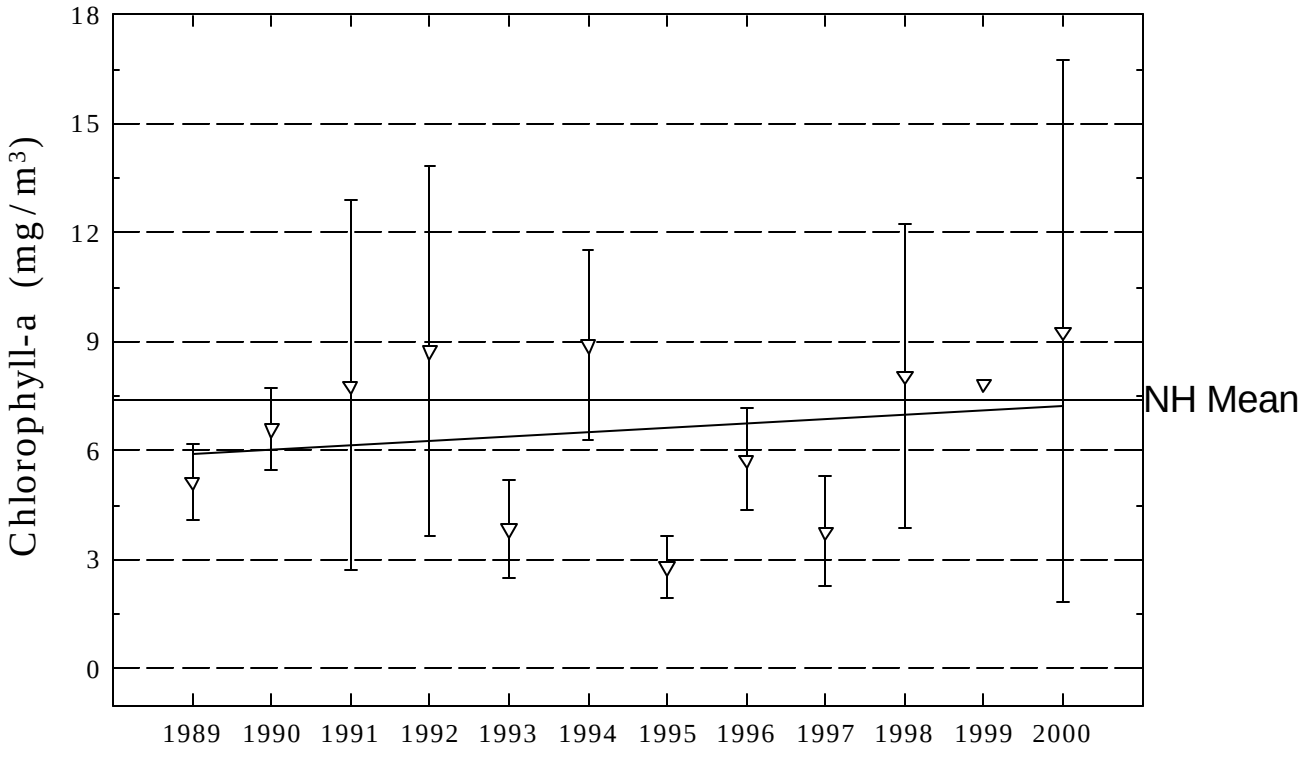
Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Zephyr Lake

Figure 1. Monthly and Historical Chlorophyll-a Results



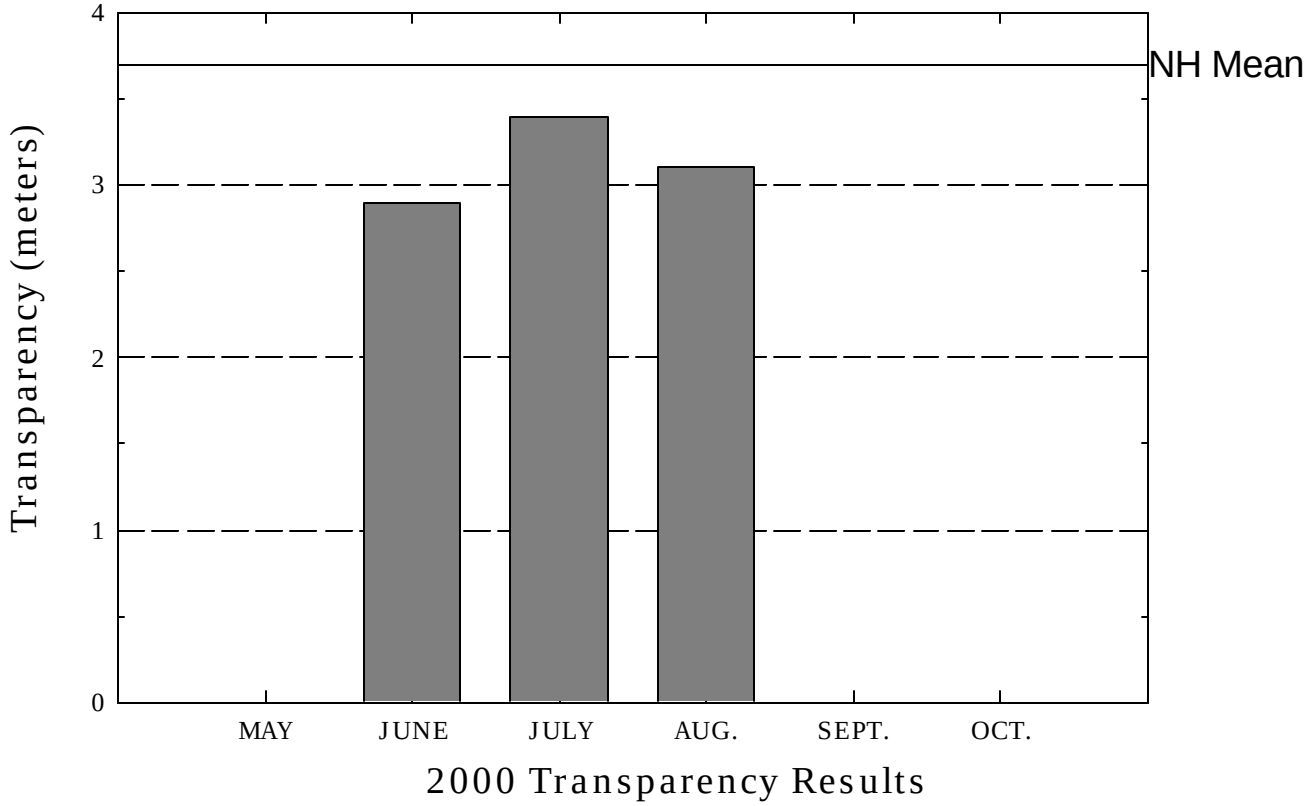
2000 Chlorophyll-a Results

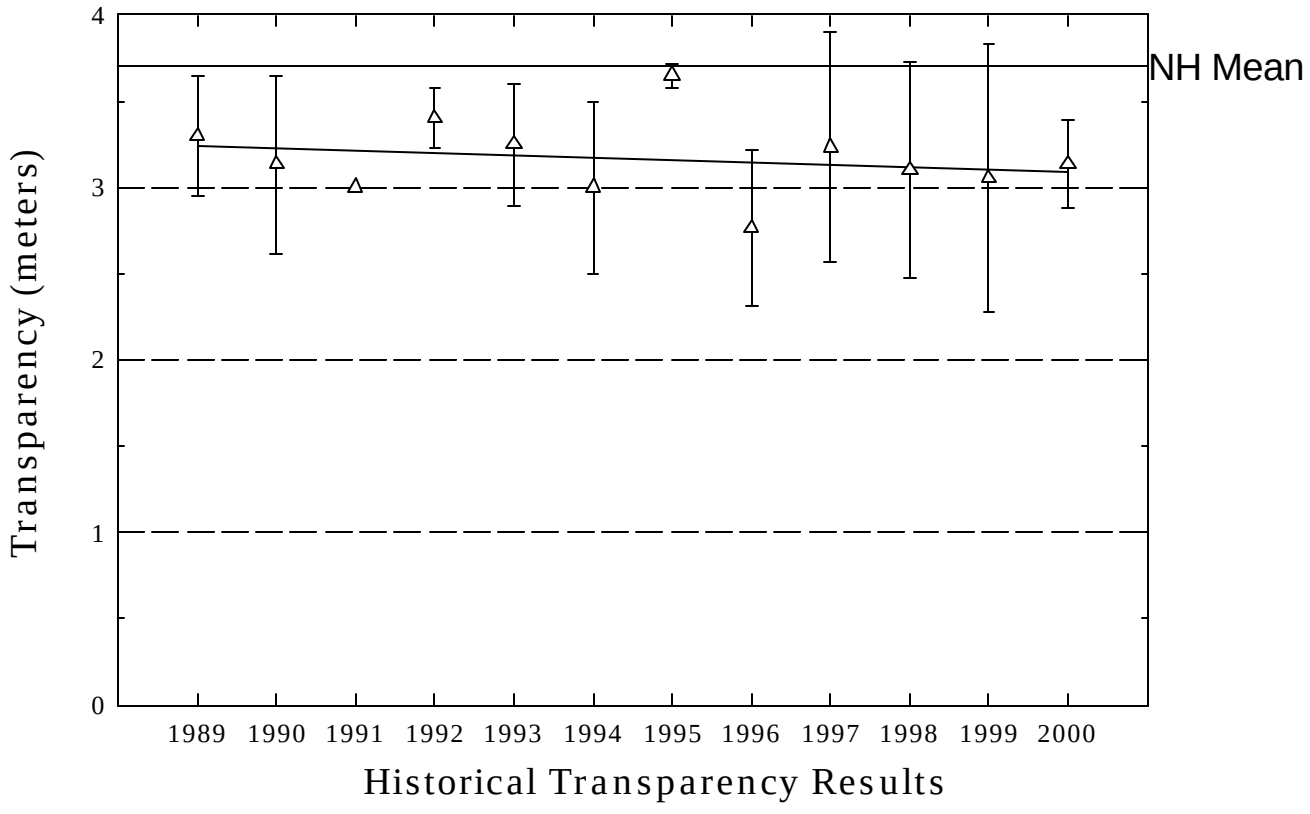


Historical Chlorophyll-a Results

Zephyr Lake

Figure 2. Monthly and Historical Transparency Results





Zephyr Lake

Figure 3. Monthly and Historical Total Phosphorus Data.

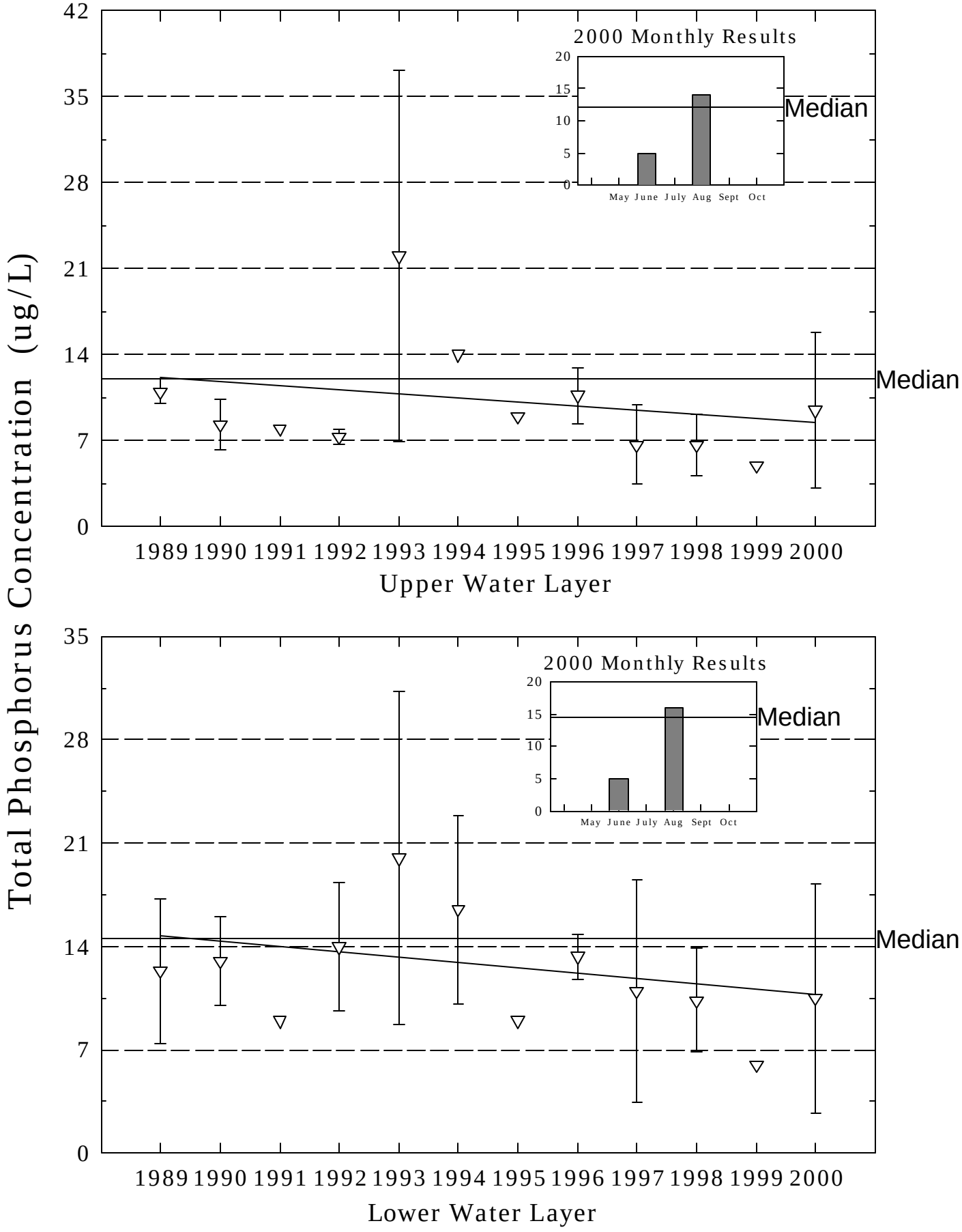


Table 1.

ZEPHYR LAKE

GREENFIELD

Chlorophyll-a results (mg/m^3) for current year and historical sampling periods.

Year	Minimum	Maximum	Mean
1989	3.95	5.97	5.14
1990	5.30	7.29	6.60
1991	4.20	11.40	7.80
1992	5.43	14.62	8.74
1993	2.45	5.12	3.86
1994	7.01	11.88	8.91
1995	2.18	3.41	2.79
1996	4.65	7.33	5.77
1997	2.02	4.72	3.77
1998	4.98	12.85	7.39
1999	7.85	7.85	7.85
2000	4.66	17.88	9.28

Table 2.

ZEPHYR LAKE

GREENFIELD

Phytoplankton species and relative percent abundance.

Summary for current and historical sampling seasons.

Date of Sample	Species Observed	Relative % Abundance
07/06/1990	DINOBRYON	33
	CHRYSOSPHAERELLA	15
	MELOSIRA	43
06/21/1991	MELOSIRA	62
	CHRYSOSPHAERELLA	20
06/19/1992	DINOBRYON	52
	CHRYSOSPHAERELLA	42
	MELOSIRA	6
06/13/1993	MELOSIRA	87
07/10/1994	MELOSIRA	82
06/07/1995	UROGLENOPSIS	78
	MELOSIRA	20
06/25/1996	MELOSIRA	56
	DINOBRYON	39
	MICROCYSTIS	4
06/27/1997	MELOSIRA	50
	TABELLARIA	20
	DINOBRYON	13
07/27/1998	RHIZOSOLENIA	25
	TABELLARIA	25
	MICROCYSTIS	25
09/01/1998	MICROCYSTIS	60
	CHRYSOSPHAERELLA	37
	MELOSIRA	2
07/02/1999	CHRYSOSPHAERELLA	66
	DINOBRYON	24
	MICROCYSTIS	5

Table 2.

ZEPHYR LAKE

GREENFIELD

Phytoplankton species and relative percent abundance.

Summary for current and historical sampling seasons.

Date of Sample	Species Observed	Relative % Abundance
06/21/2000	SPHAEROCYSTIS	50
	ANABAENA	16
	DINOBRYON	10

Table 3.

ZEPHYR LAKE

GREENFIELD

Summary of current and historical Secchi Disk transparency results (in meters).

Year	Minimum	Maximum	Mean
1989	2.9	3.5	3.3
1990	2.7	3.7	3.1
1991	3.0	3.0	3.0
1992	3.2	3.5	3.4
1993	3.0	3.5	3.2
1994	2.5	3.5	3.0
1995	3.6	3.7	3.6
1996	2.3	3.2	2.7
1997	2.8	4.0	3.2
1998	2.4	3.6	2.9
1999	2.5	3.6	3.0
2000	2.9	3.4	3.1

Table 4.

ZEPHYR LAKE

GREENFIELD

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
BEACH (W OR E??)				
	1994	7.06	7.06	7.06
EAST BEACH				
	1993	6.76	7.16	6.92
EPILIMNION				
	1989	6.94	6.98	6.96
	1990	6.70	7.16	6.93
	1991	7.20	7.20	7.20
	1992	6.80	7.08	6.96
	1993	7.09	7.28	7.17
	1994	6.68	7.19	6.92
	1995	7.01	7.01	7.01
	1996	6.72	7.06	6.89
	1997	6.81	7.00	6.93
	1998	6.74	6.89	6.81
	1999	6.94	6.94	6.94
	2000	6.79	7.12	6.93
HYPOLIMNION				
	1989	6.39	6.90	6.66
	1990	6.53	7.11	6.66
	1991	6.60	6.60	6.60
	1992	6.37	6.68	6.46
	1993	6.86	7.10	6.96
	1994	6.96	6.97	6.96
	1995	6.76	6.76	6.76

Table 4.

ZEPHYR LAKE

GREENFIELD

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
	1996	6.25	6.57	6.41
	1997	6.53	6.99	6.64
	1998	6.08	6.27	6.15
	1999	6.71	6.71	6.71
	2000	6.62	7.06	6.75
INLET				
	1991	5.20	5.20	5.20
	1992	5.04	5.23	5.16
	1994	5.40	5.40	5.40
	1995	5.02	6.66	5.31
	1996	4.85	4.85	4.85
	1998	4.80	4.80	4.80
	2000	5.31	5.59	5.41
METALIMNION				
	1992	6.79	6.89	6.84
	1998	6.28	6.28	6.28
OUTLET				
	1989	6.83	6.94	6.88
	1990	6.73	6.73	6.73
	1991	6.90	6.90	6.90
	1992	6.48	6.87	6.69
	1993	6.87	6.87	6.87
	1994	6.10	6.68	6.37
	1995	6.56	6.77	6.65
	1996	6.45	6.93	6.70
	1997	6.72	7.03	6.85

Table 4.

ZEPHYR LAKE

GREENFIELD

pH summary for current and historical sampling seasons.
Values in units, listed by station and year.

Station	Year	Minimum	Maximum	Mean
	1998	6.52	6.78	6.65
	1999	6.74	6.83	6.78
	2000	6.71	6.89	6.82
PUBLIC BEACH				
	1991	6.90	6.90	6.90
WEST BEACH				
	1993	6.95	7.07	7.01

Table 5.

ZEPHYR LAKE

GREENFIELD

Summary of current and historical Acid Neutralizing Capacity.
Values expressed in mg/L as CaCO .

Epilimnetic Values

Year	Minimum	Maximum	Mean
1989	6.30	7.60	6.77
1990	7.00	8.30	7.53
1991	5.60	5.60	5.60
1992	6.90	7.20	7.03
1993	6.80	8.20	7.63
1994	5.10	8.00	6.63
1995	6.20	6.20	6.20
1996	5.20	8.20	6.93
1997	6.60	7.70	7.27
1998	5.10	8.20	6.23
1999	7.30	7.30	7.30
2000	6.80	8.30	7.33

Table 6.

ZEPHYR LAKE

GREENFIELD

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
BEACH (W OR E??)				
	1994	94.9	94.9	94.9
EAST BEACH				
	1993	90.3	92.8	91.5
EPILIMNION				
	1989	70.4	74.6	72.3
	1990	74.8	77.8	76.7
	1991	72.2	72.2	72.2
	1992	73.3	77.1	75.3
	1993	84.7	93.5	90.2
	1994	87.8	94.3	90.9
	1995	86.2	86.2	86.2
	1996	91.8	100.6	94.8
	1997	97.3	100.8	98.9
	1998	92.3	101.4	95.5
	1999	103.3	103.3	103.3
	2000	89.7	95.1	91.6
HYPOLIMNION				
	1989	70.2	74.7	72.5
	1990	70.3	78.4	75.4
	1991	70.1	70.1	70.1
	1992	77.0	79.5	78.2
	1993	84.4	93.5	89.7
	1994	89.1	95.4	92.2
	1995	87.8	87.8	87.8

Table 6.

ZEPHYR LAKE
GREENFIELD

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
	1996	86.4	98.7	92.8
	1997	97.1	100.2	98.5
	1998	95.8	106.5	100.5
	1999	103.1	103.1	103.1
	2000	89.6	95.0	92.1
INLET				
	1991	45.9	45.9	45.9
	1992	41.4	52.6	47.9
	1994	77.7	77.7	77.7
	1995	69.1	91.8	80.4
	1996	68.1	68.1	68.1
	1998	47.3	47.3	47.3
	2000	52.0	68.6	59.1
METALIMNION				
	1992	72.5	77.1	75.5
	1998	90.2	90.2	90.2
OUTLET				
	1989	70.9	74.0	72.5
	1990	73.3	73.3	73.3
	1991	70.9	70.9	70.9
	1992	73.0	94.9	81.7
	1993	83.7	83.7	83.7
	1994	86.1	92.8	89.4
	1995	86.7	96.3	91.5
	1996	92.3	99.5	94.7
	1997	99.7	100.0	99.8

Table 6.

ZEPHYR LAKE

GREENFIELD

Specific conductance results from current and historic sampling seasons. Results in uMhos/cm.

Station	Year	Minimum	Maximum	Mean
	1998	89.6	101.7	95.5
	1999	104.5	105.6	105.0
	2000	89.2	95.0	92.4
PUBLIC BEACH				
	1991	77.0	77.0	77.0
WEST BEACH				
	1993	92.3	92.4	92.3

Table 8.

ZEPHYR LAKE

GREENFIELD

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
EAST BEACH				
	1993	12	20	16
EPILIMNION				
	1989	10	12	11
	1990	6	10	8
	1991	8	8	8
	1992	7	8	7
	1993	8	38	22
	1994	14	14	14
	1995	9	9	9
	1996	8	12	10
	1997	3	9	6
	1998	4	10	7
	1999	5	5	5
	2000	5	14	9
HYPOLIMNION				
	1989	9	18	12
	1990	10	16	13
	1991	9	9	9
	1992	9	17	14
	1993	13	33	20
	1994	12	21	16
	1995	9	9	9
	1996	12	15	13
	1997	3	18	11

Table 8.

ZEPHYR LAKE

GREENFIELD

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
	1998	5	14	9
	1999	6	6	6
	2000	5	16	10
INLET				
	1991	42	42	42
	1992	22	42	30
	1995	16	22	19
	1996	25	25	25
	1998	10	10	10
	2000	14	26	20
METALIMNION				
	1992	10	11	10
	1998	6	6	6
OUTLET				
	1989	9	31	17
	1990	11	11	11
	1991	12	12	12
	1992	8	13	10
	1993	48	48	48
	1994	10	10	10
	1995	15	20	17
	1996	9	16	11
	1997	4	9	6
	1998	4	10	7
	1999	6	7	6
	2000	6	11	8

Table 8.

ZEPHYR LAKE

GREENFIELD

Summary historical and current sampling season Total Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
WEST BEACH				
	1993	15	22	18

Table 10.

ZEPHYR LAKE

GREENFIELD

Historic Hypolimnetic dissolved oxygen and temperature data.

Date	Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
June 30, 1989	4.0	14.5	0.2	2.0
July 6, 1990	5.0	15.5	7.3	73.3
June 21, 1991	4.5	14.0	0.2	1.9
June 19, 1992	5.5	12.0	1.1	10.2
June 13, 1993	4.5	16.0	6.5	65.0
July 10, 1994	4.5	18.1	5.6	58.0
July 10, 1994	4.5	18.1	5.6	58.0
June 7, 1995	4.0	15.0	7.0	69.0
June 25, 1996	5.0	12.9	0.3	3.0
June 27, 1997	4.5	17.0	3.7	38.0
July 27, 1998	5.0	13.4	0.2	2.0
September 1, 1998	4.0	18.0	0.5	5.0
July 2, 1999	4.5	18.3	1.0	10.5

Table 11.

ZEPHYR LAKE

GREENFIELD

Summary of current year and historic turbidity sampling.
Results in NTU's.

Station	Year	Minimum	Maximum	Mean
EPILIMNION				
	1997	0.3	0.9	0.6
	1998	0.5	2.3	1.1
	1999	0.6	0.6	0.6
	2000	0.3	0.6	0.4
HYPOLIMNION				
	1997	0.7	1.5	1.0
	1998	0.5	1.3	0.9
	1999	1.2	1.2	1.2
	2000	0.5	1.2	0.8
INLET				
	1998	1.7	1.7	1.7
	2000	0.4	3.1	1.5
OUTLET				
	1997	0.6	1.0	0.8
	1998	0.3	4.8	1.9
	1999	0.6	1.2	0.9
	2000	0.2	0.7	0.4

Table 12.

ZEPHYR LAKE

GREENFIELD

Summary of current year bacteria sampling.
Results in counts per 100ml.

Location	Date	E. Coli See Note Below
BEACH		
	June 21	0

NOTE: "<" means "less than" and ">" means "greater than"